What is claimed is:

1. Apparatus for the cleaning of flue gases containing ash and sulfur dioxide produced by burning sulfur-containing coal in the combustion chamber of a circulating fluidized-bed firing system by the addition of air at a temperature of 700° to 950°C, the apparatus comprising:

means for delivering a particulate SO_2 sorbent into the combustion chamber, a portion of the SO_2 sorbent and SO_2 producing a reaction product, a portion of the SO_2 sorbent remaining unreacted;

a mixing unit;

means for feeding a mixture comprising a portion of the ash, a portion of the reaction product, and a portion of the unreacted SO_2 sorbent from the combustion chamber to the mixing unit;

means for supplying water or an aqueous sodium-containing solution to the mixing unit, the water or aqueous sodium-containing solution mixing together with the mixture of ash, reaction product, and unreacted SO_2 sorbent at a reaction temperature of 60° to 100° and at atmospheric pressure, whereby the unreacted SO_2 sorbent is converted into a hydration product; and

means for returning the ash, the reaction product, and the hydration product from the mixing unit into the combustion chamber;

wherein in the combustion chamber the hydration product is reactivated into an SO_2 sorbent at a combustion temperature of 700° to 950° C.

2. Apparatus according to claim 1 further comprising means for supplying water or for an aqueous sodium-containing solution intermediate the combustion chamber and the mixing unit.

3. Apparatus according to claim 1 further comprising means for regulating the reaction temperature of the mixing unit.

4. Apparatus according to claim 1 wherein the mixing unit includes first and second stages, the first stage receiving and mixing the mixture of ash, reaction product, and unreacted SO_2 sorbent with a first portion of the water or an aqueous sodium-containing solution and the second stage receiving and mixing the mixture from the first stage with a second portion of the water or an aqueous sodium-containing solution, the mixing of the second portion of the water or an aqueous sodium-containing solution with the mixture from the first stage of the mixing unit being regulated as a function of the residual moisture of the product that is to be carried off from the mixing unit.

5. Apparatus according to claim 1 further comprising means for regulating the dwell time of the products introduced into the mixing unit as a function of the degree of hydration of the product to be carried off.

6. Apparatus according to claim 1 further comprising means for sifting or sizing the mixture of ash, reaction product, and unreacted SO_2 sorbent disposed intermediate the combustion chamber and the mixing unit.

7. Apparatus according to claim 1 further comprising means for grinding the mixture of ash, reaction product, and unreacted SO_2 sorbent disposed intermediate the combustion chamber and the mixing unit.

8. Apparatus according to claim 1 further comprising means for drying the ash, the reaction product, and the hydration product disposed intermediate the mixing unit and the combustion chamber.

9. Apparatus according to claim 8 further comprising an intermediate store for the storage of the ash, the reaction product, and the hydration product disposed intermediate the means for drying and the combustion chamber.

10. Apparatus according to claim 1 wherein the mixing unit includes at least one nozzle for the supplying of the water or aqueous sodium-containing solution.

11. Apparatus according to claim 1 wherein mixing unit is selected from the group consisting of a plowshare, a paddle mixer and an agitator.